Undergraduate Catalog of Courses

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Biology

Saint Mary's College of California

BIOLOGY

The Biology Department offers a full range of courses designed to introduce undergraduate students to the major areas of modern biological science. The primary goals of the department are to prepare students for advanced study and research in biology and related sciences, for postgraduate study in medicine, dentistry, and the other health professions, and for careers in education, industry, agriculture, government service, and veterinary medicine. Students interested in the health professions should check the Pre-Professional section (p. 147) of the catalog for additional information. In addition, the Biology Department provides Area B courses and non-major biology courses in which students who are not science majors can learn science as a way of knowing through the study of various aspects of the life sciences and their effect on society.

FACULTY

Gerard M. Capriulo, Ph.D., *Fletcher Jones Professor, Chair*
Carla C. Bossard, Ph.D., *Professor*
Lawrence R. Cory, Ph.D., *Professor*
Margaret F. Field, Ph.D., *Associate Professor*
Allan K. Hansell, Ph.D., *Professor*
Wendy Lacy, Ph.D., *Adjunct Associate Professor*
Jacob F. Lester, Ph.D., *Professor*
Gregory R. Smith, M.S., *Professor*
Douglas J. Long, Ph.D., *Associate Professor*

LEARNING OUTCOMES

Students who graduate with a major in biology will be able to:

- **DEMONSTRATE** a solid knowledge in all three major areas of biology: molecular and cellular; organismal; and ecology and evolutionary.
- **ANALYZE** logically and critically scientific information.
- **APPLY** knowledge they have already mastered from current and previous courses to the exploration of new areas of inquiry.
- **COMMUNICATE** skillfully through written and oral reports.
- **USE** biological methodology competently for laboratory research.
- **INTEGRATE** an awareness of ethical issues with their understanding of and work in biology.

ADMISSION REQUIREMENTS

Applicants planning to undertake the biology major must present credits for one year of chemistry and four years of mathematics. One course in biology, one year of physics, and three years of a second language are strongly recommended. Students with less than a B average in high school science, mathematics and languages or with any course deficiency should seek the advice of the Admissions Office and the Biology Department before beginning their studies. A diagnostic chemistry examination is required of all students beginning a science curriculum at Saint Mary's. This examination is administered by the Department of Chemistry before the start of classes each fall and is designed to detect important deficiencies in a student's background. In some cases, the student may be advised to correct any deficiencies before undertaking the biology major curriculum. This can often be done within a four-year stay at Saint Mary's but may require summer school attendance.

MAJOR REQUIREMENTS

LOWER DIVISION

BIOLOGY MAJOR

Mathematics 27-28; Chemistry 8, 9 (lab), 10, 11 (lab); Physics 10, 11, 20 (lab), 21 (lab), or **Physics 1, 2 (lab), 3, 4 (lab);** and **Biology 1,1L (lab), Biology 2, 2L (lab).**

Lower division requirements for split majors must be determined by consultation between the student and his/her advisor and approved by the chairs of the departments involved.

UPPER DIVISION

BIOLOGY MAJOR

Chemistry 104, 105 (lab), 106, 107 (lab) The biology major must include seven upper-division biology courses of which at least five must have a laboratory component. In order to develop a broad background in biology and to experience major areas of study within the disciplines, biology majors are required to take both courses from Group I and at least one course from Groups II, III, and IV. The remainder of the seven required may come from any group.

Group I Genetics and Ecology: **Biology 105, 125**
Group II Organismal: **Biology 100, 102, 110, 113, 122, 127, 144, 146, 153**
Group III Cellular/Molecular: **Biology 130, 132, 135, 137, 139**
Group IV Evolution and Ecology: **Biology 113, 115, 120, 142, 152, 153**
Group V Electives: **Biology 116, 119**

Faculty advisors should be consulted on a regular basis to assist in selecting courses and arranging specific curricula relating to fulfillment of requirements, particular career goals, and personal interests.

All split majors with biology as the predominant area must be arranged by petition. They must have a clear emphasis, a direction, and show relatedness among the courses chosen. The specific upper-division courses selected for any split major must be arranged between the student and his/her advisor and be approved by the chairs of the departments involved.

SUGGESTED BIOLOGY MAJOR PROGRAM

A suggested four-year program of study for a major in biology is available from any Biology Department member. Note that all freshmen are required to complete two Collegiate Seminars in the first year, one each in the fall and spring terms. Two additional Collegiate Seminars must be completed before graduation, two Theology and Religious Studies courses, and other College requirements as specified in the Program of Study (see p. 39). Students majoring in science should be particularly alert to the language proficiency requirement. Students may select courses of their choice for remaining electives. It is important to note that certain upper-division courses are offered in alternate years.

MINOR REQUIREMENTS

The minor in biology requires **Chemistry 8, 9 (lab), 10, 11 (lab),** and **Biology 1, 1L (lab), 2, 2L (lab).**

Any three upper-division biology courses, two of which must have a laboratory component. Note that all courses have prerequisites. The specific upper-division courses selected for the minor must be arranged between the student and his/her advisor and be approved by the chairs of the departments involved.

JANUARY TERM

Frequently, faculty members in the Biology Department offer courses during the January Term. Since it is the policy of the department to provide a variety of learning experiences during this term, the following kinds of courses are often offered: (1) Seminars designed to probe special areas of current interest in the biological sciences through readings in the primary literature, preparation of reports, and class discussions; (2) Field courses, based either on campus or at a field site, that provide experience in the study of natural ecosystems; (3) Directed research into topics in experimental or field biology of interest to faculty and students; (4) Independent study courses either on campus or by special arrangement at universities or research institutions. It is the general policy of the department that courses taken during the January Term cannot be used to fulfill biology majors' credit.

PREPARATION FOR MEDICINE, DENTISTRY, AND OTHER HEALTH PROFESSIONS, AND VETERINARY MEDICINE

See the section in this catalog under Pre-Professional Curricula (p. 147).

PREREQUISITE GRADE

Any course listed in this department with a prerequisite assumes a grade of C– or better in the prerequisite course.

COURSES

LOWER DIVISION

1 Introductory Biology for Majors: Cell and Molecular Biology and Genetics

This is the first semester of a two-semester sequence designed for biology majors and others requiring a rigorous treatment of the subject. It is designed to prepare students for in-depth, upper-division work in areas related to cell and molecular biology and biochemistry and genetics. Three hours of lecture per week. *Prerequisites:* **Chemistry 8, 9 (lab), 10 and 11 (lab)** with grades of C- or better. Must be currently enrolled in **Biology 1L.**

1L Introductory Biology for Majors: Cell and Molecular Biology Laboratory

Laboratory to accompany **Biology 1.** One laboratory per week for four hours. Must be currently enrolled in **Biology 1.** Laboratory fee $185 (includes lab manual).

2 Introductory Biology for Majors: Evolution and Organism

This is the second semester of a course designed for biology majors and others requiring a rigorous introductory treatment of the subject. This course is a systematic introduction to all forms of life, covering all three domains (formerly five kingdoms), from bacteria and protozoa, through fungi, plants, and animals. To account for life's unity and diversity, the guiding principle for the course is the concept of evolution. **Biology 2** builds upon the cellular and molecular foundation given in **Biology 1** (which is pre-required for **Biology 2**), and assumes knowledge of hereditary principles, both Mendelian and molecular. Through the study of the molecular evidence, morphology, physiology, development, and behavior of each type of organism, we provide a broad understanding of the evolutionary origins and phylogenetic relationships of all forms of life. Required for biology majors and prerequisite to ALL upper division courses. Three hours of lecture per week. Prerequisites: **Chemistry 8, 9 (lab) , Chemistry 10, 11 (lab), Biology 1, 1L,** with a grade of C– or better. Must be concurrently enrolled in **Biology 2L.**

2L Evolution and Organisms Laboratory

Laboratory to accompany **Biology 2.** One laboratory per week for four hours. Must be currently enrolled in **Biology 2L.** Laboratory fee $175.

5 Concepts in Evolutionary Biology

This question-oriented course designed for non-majors explores how science works through an examination of the concepts of the theory of evolution by natural selection, which is considered to be the unifying theme of the biological sciences. Three lecture hours and one lab per week. Fulfills Area B requirement. Laboratory fee $175.
Offered in alternate years.

6 Human Genetics: Issues and Applications

An introduction to the basic concepts and technologies of genetics as they apply to humans and the ethical issues that arise as a result of the application of those principles. Students will engage these areas through lectures, discussion, guest presenters, videos and hands-on laboratory experiences. Intended for students in any major regardless of background. Six hours of lecture/discussion/laboratory per week. Fulfills Area B requirement. Laboratory fee $185 (includes reader).
Offered in alternate years.

7 Introduction to Biological Anthropology
Study of the variation and evolution of the human species and its place in nature. Molecular, Mendelian and population genetics serve as a basis to discussions of natural selection and how that affects biological and physiological adaptation. The emphasis of this course is directed toward why we see broad variations among homo sapiens and how these variations affect humans in their life cycle, health and culture. Three lecture hours and one three-hour lab per week. Laboratory fee $175.

10 Introduction to Biology
Study of the chemistry of life, the organization of cell and the molecular processes inside of cells. This course emphasizes the genetic basis of life and includes an introduction to biotechnology. Designed for 2+2 Pre-Nursing students as a prerequisite for microbiology, human anatomy and human physiology. Three hours of lecture per week. Must be accompanied by **Biology 11.**

11 Introduction to Biology Laboratory
Laboratory to accompany **Biology 10.** Includes techniques for studying organic molecules, cell biology and genetics. One lab per week for three hours. Laboratory fee: $175

15 Human Anatomy
Study of the gross and microscopic structure of the human body. This course, emphasizing the structural relationships and functional aspects of gross anatomy, proceeds from the cell to tissues to organs. A strong high school science background is recommended. Three hours of lecture per week. Concurrent enrollment in **Biology 16** is required for enrollment in **Biology 15.** Limited to majors in biology, health science, kinesiology, and nursing or by consent of instructor. Does not qualify for Area B.

16 Human Anatomy Laboratory
Laboratory to accompany **Biology 15.** Laboratory will be taught from dissected human material, models and microscopic slides to allow students to learn from direct experience. One three-hour lab per week. Must be concurrently enrolled in **Biology 15.** Laboratory fee $175.

25 Human Physiology
Study of the function of the major organs and organ systems of the human body. This course, emphasizing regulation and integration, proceeds from general cell function to an overview of the controlling mechanisms and finally to the individual systems. A strong high school science background is recommended. Three hours of lecture per week. Concurrent enrollment in **Biology 26** is required for enrollment in **Biology 25.** Limited to majors in biology, health science, kinesiology, and nursing or by consent of instructor. Does not qualify for Area B.

26 Human Physiology Laboratory
Laboratory to accompany **Biology 25.** The laboratory consists of experiments and demonstrations designed to incorporate principles of physiology. One three-hour lab per week. Must be concurrently enrolled in **Biology 25.** Laboratory fee $185 (includes lab manual).

40 Introductory Microbiology
The biology of microorganisms including bacteria, viruses, and fungi, with emphasis on those forms of medical importance to man. Three hours of lecture per week. Must be concurrently enrolled in **Biology 41.**

41 Introductory Microbiology Laboratory
Laboratory to accompany **Biology 40.** Includes techniques for culture, isolation, characterization, and identification of microorganisms. One lab per week for three hours. Must be concurrently enrolled in **Biology 40.** Laboratory fee $175.

50 General Biology
A one semester introduction to the basic principles and concepts of biological science. Designed for students not majoring in biology. Three hours of lecture per week. Must be concurrently enrolled in **Biology 51.** Fulfills Area B requirement,

51 General Biology Laboratory
Laboratory to accompany **Biology 50.** One lab per week for three hours. Must be concurrently enrolled in **Biology 50.** Laboratory fee $175.

52 The Symbiotic Universe
An interdisciplinary science course which in addition to inter-science syntheses forges into areas of theology, philosophy, the social sciences, and the nature of good and evil. It is designed for both non-science and science majors, and fulfills an Area B requirement. The course explores original ideas concerning the role played by symbiosis in the origin of the universe, the earth, and life on earth, and in the development of the earth's ecosystems. It argues that phases of creation are organized around the principles of symbiotic mutualism. It suggests that such cooperation is dictated by the laws of physics and therefore was established at the moment of creation. This universal thread of symbiosis is evident in the formation of atoms, elements and matter, chemical interactions, star and planetary systems, and simple to complex life forms. It drives evolution from the primordial soup to cells, multicellular organisms, populations, communities and ecosystems, and human societies as well. One lab per week for three hours. Laboratory fee $175.

55 Ocean World
An introductory course that examines the ocean world and its inhabitants. Topics include physical and chemical properties of sea water; tides and currents; geological principles; coastal and open ocean habitats; life in planktonic and benthic communities; coral reef, hydrothermal vent and mangrove ecosystems. Three hours of lecture per week. One lab per week for three hours. Fills Area B requirement. Laboratory fee $175.

80 Human Biology
This is a course to connect basic biology concepts using the human as an illustrative example. Basic scientific processes and the concepts of human biology will be explored through lecture and laboratory exercises. Topics will include science and society, the chemistry of living things, structure and function of cells, genetics, anatomy and physiology of the organ systems, reproduction, cancer, aging, evolution, human impacts, and environmental issues. Open to all students interested in discovering the scientific process and the concepts of human biology. One three-hour lab per week. Fills Area B requirement.

81 Human Biology Laboratory
Laboratory to accompany **Biology 80.** One lab per week for three hours. Must be concurrently enrolled in **Biology 80.** Laboratory fee $175.

88 **Biology of Women**
Biology of Women is an introduction to the structure, physiology, and genetics of women across the life span. The first half of the course will explore the genetic, hormonal, and developmental basis of gender. We will study physiology and development from conception, through puberty, pregnancy, and aging. The latter part of the course will deal with specific health concerns of women and focus on predominantly or uniquely gender-related illnesses and their physiologic basis. The laboratory is intended to demonstrate the varied processes of science and the scientific method using women's biology as the basic subject material. Open to men and women. Fulfills area B requirement. Laboratory fee $175.

89 **Biology of Women Laboratory**
Laboratory to accompany **Biology 88.** One lab per week for three hours. Must be concurrently enrolled in **Biology 88.** Laboratory fee $175.

UPPER DIVISION
Each upper-division course has prerequisites of ***Biology 1, 1L*** *and* ***2, 2L*** *with a grade of C– or better in each of these prerequisites.*

100 **Comparative Anatomy**
The course examines vertebrate form and function through the topics of vertebrate evolution, functional morphology, and development, along with the study of soft tissues, organ systems, and skin. Three lecture hours and two labs per week. Laboratory fee $175.
Offered in alternate years. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L.**

102 **Developmental Biology and Embryology**
Explores the processes and patterns of fertilization and embryonic development of animals with an emphasis on mechanisms controlling cell differentiation and morphogenesis. Three lecture hours and one lab per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L** and **Chemistry 104, 106.** Laboratory fee $175.
Offered in alternate years.

105 **Genetics**
Principles of biological inheritance in animals, plants, and including some consideration of classical, molecular, population and human genetics. Three hours per week of lecture and one lab per week for four hours. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L.** Laboratory fee $175.

110 **Parasitism and Symbiology**
A comprehensive course in parasitology, focusing on the many facets of symbiosis common to every level of biology. It embraces the three basic types of intimate interrelationship between different species of organisms: parasitism, mutualism and commensalism. This course examines an array of interactions in all three types of interrelationships, at many levels of interdependency. All five kingdoms, from bacteria, protoctists, and fungi to plants and animals, are studied. Three lecture hours and one lab per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L.** Laboratory fee $175.
Offered in alternate years.

113 **Marine Biology**
Examines marine life in terms of physiological, evolutionary, systematic and ecological principles. Topics covered include: marine procaryotes, unicellular eucaryotes and the multicellular eucaryotes (i.e., the invertebrates, vertebrates and marine plants). The organization of and interrelationships among marine organisms and their environments are considered from an ecosystem perspective. Shallow and deep benthic, intertidal, estuarine, coastal water, coral reef and open ocean systems are examined in detail. Three lecture hours and one lab per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L.** Laboratory fee $175.
Offered in alternate years.

115 **Theory of Evolution**
Historical development of evolutionary theories. Modern concepts concerning the process of organic evolution, including population genetics, natural selection, and the origin of species. Topics on macroevolution, including adaption and extinction. Three hours of lecture per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L. Biology 105** highly recommended.
Offered in alternate years.

116 **History and Philosophy of Biology**
Development of the major concepts of biology from antiquity to the modern era, with a consideration of what these developmental sequences show about the nature of the scientific process. Three hours of lecture per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L.**
Offered in alternate years.

119 **Research Design and Biostatistics**
Principles of experimental design, sampling methodologies, data collection and analysis are discussed, along with practical applications of these area in biological experimentation. Course includes use of computers. Three lecture hours and one lab per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L.** Laboratory fee $175.

120 **Vertebrate Zoology**
Advanced study of the vertebrates, with attention to phylogeny, morphology, and natural history of the major vertebrate groups. Laboratory and field work emphasize taxonomy of local forms, methods of study, and special projects. Three lecture hours and one lab/field period per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L.** Laboratory fee $175.
Offered in alternate years.

122 **Comparative Animal Physiology**
The functions of the major organ systems of vertebrate and invertebrate animals. Emphasis on general principles of function as exemplified in the major animal phyla. Three lecture hours and one lab per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L, Chemistry 104, 106.** Laboratory fee $175.
Offered in alternate years.

125 **General Ecology**
An examination of the classical and emerging concepts of ecology from a primarily but not exclusively descriptive perspective. Topics include: comparative study of marine, freshwater and terrestrial systems; global warming; population ecology; the decomposition cycle; nutrient cycling; concepts related to niche theory, fitness, competitive exclusion, natural selection, and evolution. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L.** Laboratory fee $175.
Offered in alternate years.

127 **Systemic Physiology**
Fundamental principles of general mammalian physiology combined with physiology of organ systems; including integrative and homeostatic mechanisms. Emphasis is on human physiology with examples taken from mammalian systems. Application of these principles to interpretation of disease is included. Laboratory includes human and mammalian experiments with emphasis on instrumentation and interpretation of results. Three lecture hours and one lab per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L, Chemistry 104, 106.** Laboratory fee $175.

130 **Microbiology**
An introduction to the structure, physiology, and genetics of microorganisms with focus on bacteria and viruses. The application of fundamental knowledge about these organisms to problems of medical microbiology is included. Laboratory involves application of bacteriological techniques to the study of taxonomy, physiology and genetics of bacteria and viruses. Three hours of lecture and two two-hour labs per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L, Chemistry 104, 106.** Laboratory fee $175.
Offered in alternate years.

132 **Cell Biology**
A special topics course in which selected areas of current interest in cell biology are studied. Choice of topic varies (e.g., membrane structure and function, nerve and muscle, control of cell division, cellular immunology). Emphasis is placed on experimental methods and answering the question "How do we know what we know?" Lab includes extensive exposure to cell culture methods. Three hours of lecture and one lab per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L, Chemistry 104, 106.** Laboratory fee $175.
Offered in alternate years.

135 **Biochemistry**
An introduction to the metabolism of proteins, lipids, and carbohydrates. Consideration is given to the properties of enzymes and enzyme catalyzed reactions in the cell. Applications to human function, disease, and diet are included. Three hours of lecture and one lab per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L, Chemistry 104, 106.** Laboratory fee $185.

137 **Molecular Biology**
An introduction to the structure and function of the genetic apparatus. This course is a study of what genes are and how they operate, and includes recent discoveries in the areas of DNA, RNA, and protein synthesis in both prokaryotes and eucaryotes. Laboratory includes both discussion and practice of techniques used in genetic engineering. Three hours of lecture and one lab per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L, Chemistry 104, 106.** Laboratory fee $185.

139 **Immunology**
An introduction to the immune system: its components, how it functions, how it is regulated and how it is protective. The immune response and our ability to react to such a diversity of molecules with specificity are discussed in detail. In addition, the immuno-logic basis for tissue/organ transplant rejection, disease prevention vaccines and cancer immunotherapy are presented. Three hours of lecture and one lab period per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L, Chemistry 104, 106.** Laboratory fee $175.

142 **California Flora and Communities**
Survey of selected plant communities of California. Includes a dual emphasis on field recognition of important plant families and genera of these communities and an understanding of the relationship of the component species to their environment. Three lecture hours and one lab per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L.** Laboratory fee $175.
Offered in alternate years.

144 **General Botany**
The study of plant biology at an advanced level, including topics in the structure and development, reproductive patterns, taxonomy, identification, phylogeny, and distribution of major plant groups. Three lecture hours and one lab per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L.** Laboratory fee $175.
Offered in alternate years.

146 **Plant Ecophysiology**
The functional aspects of plant life and the relation of plants to their physical, chemical, and biological environment. Emphasis on the vascular plants. Three lecture hours and one lab/field period per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L.** Laboratory fee $175.
Offered intermittently.

152 **Conservation Science**
Conservation biology is a field of biological science that draws upon the principles of ecology, genetics and evolution in an effort to understand the patterns and processes underlying the biological diversity of our planet. The course examines the current status of our scientific understanding of biodiversity, threats to biodiversity resulting from human activities, and strategies to conserve and restore the integrity of the earth's biological systems. Course activities include case studies, computer modeling and field trips. Three hours of lecture and one lab/field period per week. *Prerequisites:* **Biology 1, 1L** and **Biology 2, 2L.** Laboratory fee $175.
Offered in alternate years.

197 **Special Study**
An independent study course for students whose needs are not met by courses available in the regular offerings of the department. Permission of the instructor and the department chair required. Laboratory fee, when appropriate, $175.

199 **Special Study—Honors**
A research course for upper division majors with a B average in biology. Permission of instructor and department chair required. Laboratory fee, when appropriate, $175.